

INVITED COMMENTARY

Importance of Venous Inflow: Emergence of the Invisible Gorilla

Rick de Graaf ^{a,*}, Michael Lichtenberg ^b^aRadiology Department, Klinikum Friedrichshafen, Friedrichshafen, Germany^bVascular Centre Arnsberg, Klinikum Hochsauerland, Arnsberg, Germany

Deep venous interventions and the development of new devices to improve outcome have gained popularity rapidly in recent years. In the paper by Morris *et al.*¹ in this issue of the journal, the authors have attempted to further scrutinise this interesting field, more specifically venous stenting. They tried this by focusing on the type of venous stent, which is an understandable approach. The single most important variable in deep venous interventions since the pioneering work of Neglen and Raju² in the early years of the twenty first century is the “dedicated” venous stent. Setting it apart from the commonly used Wallstent, the newer venous stents are laser cut or have a woven nitinol design. These stents were primarily designed with the purpose of improving safe and accurate deployment, decreasing complications, and, most importantly, increasing patency. Perhaps unexpectedly, the results from stent performance studies in the last decade did not prove that novel stent design improves outcome, especially when specific pathology like non-thrombotic iliac vein lesions or post-thrombotic lesions are evaluated for secondary patency. The present study did not show a performance difference between open cell (OC) and closed cell (CC) venous stents, and thereby independently substantiates the steady performance of the currently available venous stents. However, the two stents in the OC group do have significantly different characteristics in radial resistive force, chronic outward force, and flexibility,³ which makes a reliable comparison with the examined CC stent challenging. Moreover, the suggestion that CC stents require multiple re-interventions when placed across the inguinal ligament maybe a little reductive, considering that only one CC stent was evaluated. Other CC stents may perform differently based on their specific design. For example, the Blueflow Venous Stent (Plus Medica GmbH, Germany), also a CC design, is a novel braided nitinol venous stent specifically

designed to perform better in the pelvic veins and crossing the ligament.⁴

While stent performance differences did not prove to be a decisive factor in stent patency, significant and very attractive data put forward by the study showed that venous inflow did qualify as a dominant factor for stent patency. Obviously, without sufficient inflow, stents are more likely to thrombose. The questions are, of course, how much inflow is enough for individual patients, and do we have tools at our disposal to circumvent insufficient inflow (e.g., oral anti-coagulation, distal deep venous interventions, or artificial inflow improvement)? Evidently, increased emphasis should be placed on this extremely important variable.

Recently, two companies (BD and Boston Scientific) withdrew their venous stents from the market, which raises questions. Subsequently, continuous efforts to evaluate venous stent performance by venous experts are desirable to help the industry design the best venous stent possible to improve patient outcome. For this, the authors should be praised.

REFERENCES

- 1 Morris R, Jackson N, Khan T, Karunanithy N, Thulasidasan N, Smith A, et al. Performance of open and closed cell laser-cut nitinol stents for the treatment of chronic iliofemoral venous outflow obstruction in patients treated at a single-centre. *Eur J Vasc Endovasc Surg* 2022;63:613–21.
- 2 Neglén P, Raju S. Balloon dilation and stenting of chronic iliac vein obstruction: technical aspects and early clinical outcome. *J Endovasc Ther* 2000;7:79–91.
- 3 Dabir D, Feisst A, Thomas D, Luetkens JA, Meyer C, Kardulovic A, et al. Physical properties of venous stents: an experimental comparison. *Cardiovasc Intervent Radiol* 2018;41:942–50.
- 4 Lichtenberg M, Stahlhoff S, Özkapi A, de Graaf R. Braided nitinol stent for chronic iliofemoral venous disease - the real-world BLUEFLOW registry. *Vasa* 2021;50:372–7.